Spatial Information Needs on the Fishlake National Forest: Can FIA Help?

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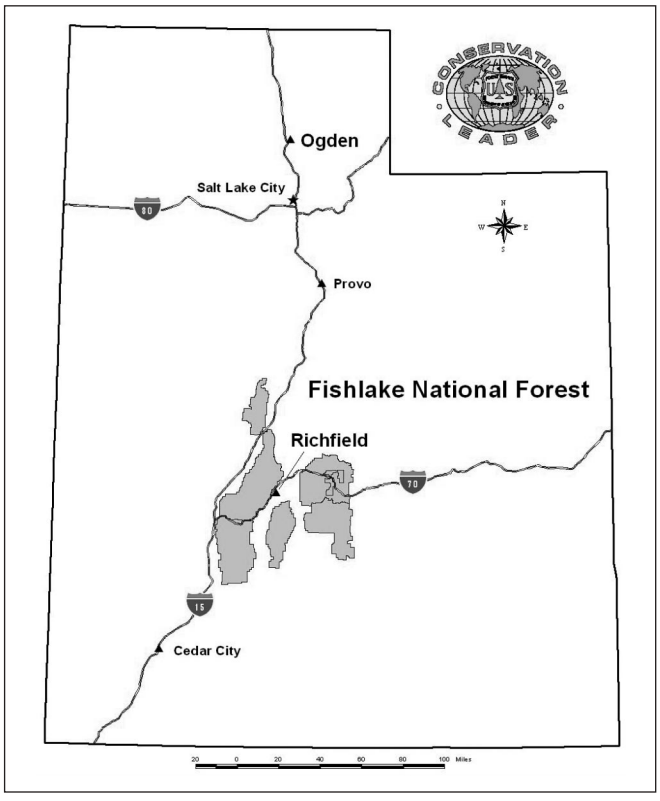
Abstract.—National forest staff members are frequently challenged to make assessments with existing information. They rarely have the time or resources to go to the field to gather new data specific to the question at hand. Forest Inventory and Analysis (FIA) data have proved useful in the past, but there is an increasing need for spatial depictions of forest resources to address management and planning issues. For example, maps are needed to assess healthy stands, suitable wildlife habitat, marketable harvest areas, desired future conditions, and historical distribution of forest types. The success of FIA-generated map products hinges on good communication with map users throughout the mapmaking process, adequate development and accuracy assessment, ecological integration, and rigorous field testing.

This paper introduces the Fishlake National Forest (FNF) and describes the collaboration that occurs between the Rocky Mountain Research Station's (RMRS) Interior West Forest Inventory and Analysis (IWFIA) unit in Ogden, Utah, and FNF. This paper also provides the contextual backdrop for multiple papers presented at this conference that report various projects underway on the FNF (Edwards *et al.* 2004, Frescino and Moisen 2004, Schultz, R.J. 2004, Terletzky and Frescino 2004). The FNF benefited immensely from interactions with the RMRS-IWFIA staff in Ogden.

The Forest needs mapped information, and FIA products that spatially refine data would benefit the FNF. This paper presents a background discussion on the goals of the Forest to sustain biodiversity and maintain properly functioning ecosystems. It follows with a brief historical background of the utility of past IWFIA products and the coordination between the Forest and IWFIA for meeting the needs of the Forest. It ends with a discussion of the current situation in the Forest, and again, the need and desire for IWFIA spatial products. The paper is as much about the *process* as it is about the *products*. Thus, this paper describes the synergy that results from the collaboration of Forest managers and specialists with Station scientists and researchers.

The FNF occupies about 1.5 million acres in south-central Utah (fig. 1). The Supervisor's office is in Richfield on I-70, 40 miles east of the western terminus of I-70 with I-15. The Forest features incredible landscape and biological diversity. Elevations range from 5,000 feet to over 12,000 feet. The highest point lies in the southwestern part of the Forest; Delano Peak in the Tushar Mountains stands at 12,169 feet. In addition to ragged peaks, sweeping high elevation plateaus are blanketed with mixed-conifer and aspen forests. The Forest's eastern edge is bounded by the arid, rugged terrain of Capitol Reef

Figure 1.—*Vicinity map of Utah and the Fishlake National Forest.*



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National Park and the San Rafael Swell. Annual precipitation on the Forest varies from less than 8 inches to more than 40 inches. Recent assessments focused on Monroe Mountain, the Beaver River Watershed, and the Fishlake Basin/Sevenmile Creek in the upper Fremont River drainage. Fish Lake, at 8,800 feet and about 5 miles long by 1 mile wide, is deep, cold, and considered by many to be Utah's "crown jewel." Wilderness areas, either existing or proposed, do not occur on the Forest. Resource themes important to the Forest's landscapes include fuels, timber, and wildlife. Also, the FNF is in the initial revision phase of land and resource management planning.

Definitions and Concepts

Biodiversity and Properly Functioning Condition

Biological diversity is often described in terms of composition, structure, and function. Composition is described by the numbers and kinds of plants and animals. Structure relates to the sizes, shapes, and/or ages of the plants and animals. Function (or process) has to do with what happens in the ecosystem. For example, disturbance regimes like fire, flood, or windthrow are all types of functions and ecosystem processes. Also, function includes the contribution each plant and animal species provides to the ecosystem.

The Forest Service's Intermountain Region began a process in 1996 that expanded the Bureau of Land Management's concept of proper function condition in riparian areas to the proper**ly** functioning condition (PFC) of the major upland vegetation cover types (USDA Forest Service 1998, 2000a). This PFC approach provided an ecological basis for the rapid assessment of general conditions of sustainability on large landscapes. Properly functioning condition is defined with this statement (USDA Forest Service 1998, 2000a, 2000b):

> Ecosystems at any temporal or spatial scale are in properly functioning condition when they are dynamic and resilient to perturbations to structure, composition, and processes of their biological or physical components.

Because that definition is fairly technical, Campbell and Bartos (2001) suggest another definition for use with general audiences (e.g., school classes or public meetings) that is less technical, yet attempts to convey the same meaning:

> Properly functioning condition exists when soil and water are conserved, and plants and animals can grow and reproduce and respond favorably to periodic disturbance.

PFC is not a single state in space or time. PFC includes a range of situations and conditions that allow for the full variation of composition and structure within the processes of sustainable functioning ecosystems for that specific major vegetative cover type.

Often our stakeholders, both internal and external, Forest employees, county commissioners and city leaders, Forest users (permittees, recreationists, loggers, summer home owners, etc.) and students (younger or older) really do not care what the statistical difference or R^2 is if they can not see the difference on the ground. Maps that display the elements of biodiversity, particularly composition and structure, would be useful to describe and explain concepts of biodiversity.

Major Vegetation Communities and Biodiversity Loss

Major vegetation cover types on the FNF include spruce/fir, aspen, mixed-conifer/aspen, ponderosa pine, curl-leaf mountain mahogany, Gambel oak, pinyon/juniper, and sagebrush/grass/forb. These cover types are fire adapted and have many traits that allow periodic fire to be a stimulant and a healthy process to sustain them.

Periodic fires maintain structural diversity within vegetation cover types. Cover type conversions, in the absence of fire, result in a loss of compositional biodiversity. The FNF now has an absence of historical fire regimes combined with substantial increases in ungulate use, both domestic and wildlife. With these changes in disturbance patterns, aspen is being replaced by spruce/fir; aspen is being replaced by sagebrush/grass/forb; and sagebrush grass forb is being replaced by pinyon/juniper. This results in loss of ecosystem function; biodiversity and sustainability are compromised. Maps of the structure and composition of major vegetation cover types would be especially useful to forest managers to demonstrate potential loss of function.

History, Applications, and Use of IWFIA Products

Second Generation Use of Data and Synergy

Forest specialists are often challenged to complete assessments with existing information. The second generation use of data is simply this: use previously gathered data to answer questions that were not conceived at the time the original data were collected. This results from collaboration that leads to synergy.

A landmark meeting involving IWFIA researchers and Intermountain Region employees was held in Ogden, Utah, in November 1995. Most of the six national forests in Utah were represented, and scientists from other Station research work units attended. The standard IWFIA products were displayed and discussed. Then the question was posed, what other products would be useful? It would be difficult to overstate the value of the s*ynergy* that began at that one meeting!

Resource Reports for Utah Forests

One idea expressed at the November 1995 meeting was the desire to have a brief report of the forest resources. The outgrowth of that idea expanded to a glossy, forest report for each of the six forests in Utah (O'Brien and Brown 1998, O'Brien and Collins 1997, O'Brien and Pope 1997, O'Brien and Tymcio 1997, O'Brien and Waters 1998, O'Brien and Woudenberg 1998).

Ron Sanden, FNF Forest Silviculturist (retired), described his experiences with and the value of the *Forest Resources of the Fishlake National Forest* (O'Brien and Waters 1998) (personal communication):

> I took copies of the Fishlake report to all of the meetings that I attended that first year or two. I love the report. It is the most valuable handout or pamphlet that I have used to explain the Fishlake's forest resources.

The collaboration and synergy continued as these reports were prepared. Additional input from FNF employees led to the development of a bar chart in the Fishlake report that displayed acres by age class for each of the forest types. Actually, the bar chart displayed the magnitude of structural diversity within each forest type. The information proved quite useful during various assessments completed on the FNF. Now we need this kind of information on structural diversity mapped and displayed spatially.

Initial Use of IWFIA Data

Another outgrowth of the November 1995 meeting was to query the IWFIA database in ways that demonstrated the magnitude of aspen decline in Utah. Aspen decline occurs when landscapes with aspen are outside of properly functioning condition. The results of these refined queries of the IWFIA database showed that the six forests in Utah have had nearly a 60-percent decline in aspen forest types from nearly 2.1 million acres to less than 0.9 million acres (Bartos and Campbell 1998a, 1998b). Again, managers would benefit greatly if this information were mapped.

The FNF completed a forestwide assessment of historical, existing, and desired vegetation conditions during 1997 and 1998 as a part of its Prescribed Natural Fire Plan (Jackson *et al.* 1998). (The current terminology is now Wildland Fire Use Plan.) The IWFIA data were extremely useful in developing the assumptions used to determine what the historical abundance of the major vegetation cover types had been. Forest Supervisor Rob Mrowka awarded Renee O'Brien a Certificate of Merit for special effort in collaboration and for displaying forest resources data that allowed interpretation of historical vegetation cover for the Fishlake National Forest's Prescribed Natural Fire Plan.

IWFIA data are also used to help people understand how much the Forest's landscapes have changed in the past 200 years. A table of acres in each stand-age class by forest type (O'Brien 1999) was derived from a consistent, uniform, FIA data set for all of Utah. The 50-year stand-age classes included nearly 15 million acres of forests and woodlands for all ownerships in the State. Again, however useful this information is now, it would be highly desirable to have this structural diversity mapped.

Use of the 4 C's to Determine Desired Conditions

Campbell and Bartos (2001) describe 4 C's used to determine desired conditions.

Commitment—devote the time and resources to allow the process to occur and mature.

Communication—talk and interact willingly and openly with each other.

Collaboration—promote intense and enthusiastic sharing of information.

Cooperation—work together; walk the talk; make it happen!

These concepts certainly apply to determining the use of IWFIA map data as well. The RMRS-Ogden IWFIA group continues to promote these 4 C's. During the past 3 years, Renee O'Brien (RMRS), Gretchen Moisen (RMRS), Tracey Frescino (RMRS), and Tom Edwards (Associate Professor, Utah State University) made three trips to the FNF Supervisor's Office in Richfield. A variety of different mapping projects were discussed and planned for the FNF. These efforts also led to Randy Schultz (USU graduate student) spending two summers on the Fishlake gathering wildlife habitat data for his project. Ogden-IWFIA researchers interacted on numerous occasions with more than a dozen Forest specialists. The FNF benefited from these associations and the resulting synergy with the IWFIA researchers. Forest specialists could not have completed various assessments without the IWFIA products.

Current Situation

Studies in the Beaver River Watershed

The FNF is fortunate to have several studies completed, ongoing, or proposed in the Beaver River watershed with about 123,000 acres administered by the Forest Service. Researchers from six units of RMRS and Utah State University have visited this watershed. The Beaver River drainage was the FNF's flagship watershed assessment for 2002. As a result of that assessment, nearly 20 projects were identified as ways to restore and sustain properly functioning conditions. The IWFIA group is working on structural diversity and wildlife habitat maps, as well as projects with ultra-low-level aerial photography and high resolution mapping from satellite images. The watershed is a focus area for a large fuels modeling project in addition to a tree-ring analysis of fire history. RMRS scientists also desire to study treatments in the pinyon/juniper type and forage reduction associated with decline of the aspen cover type.

Was it coincidence that all of these studies included portions of the Beaver River drainage? No, it did not just happen. The FNF began to focus attention on the drainage a few years ago. Since the FNF is considered by many to be a research-friendly study area, when RMRS scientists and university professors asked if there were any areas where a particular study might occur, the response from Richfield was usually the Beaver River watershed. And some of the studies are there because of serendipity. Whatever the reason, the result is that the FNF is amassing a substantial database about this biologically diverse as well as socially and economically important watershed.

Mapping of Spatially Explicit Information

We tie back to the elements of biodiversity and consider composition and structure again. Most forests have compositional diversity data mapped to some extent. However, many forests do not have forestwide maps more refined than for land type associations. The FNF and most other forests lack maps of structural diversity. However, an exception to this would be forests with predominantly timber resources.

The FNF is beginning the forest plan revision process. IWFIA products would be useful at many stages of the revision process. Such products will provide credible scientific underpinnings for the analyses that will lead to a revised land and resource management plan. Current needs for specific information include hazardous fuels treatments, fuel loadings, timber harvests linked to spruce beetle epidemics, and wildlife management indicator species (e.g., goshawk, cavity nesters, sagebrush guild, deer, and elk).

Resource Questions and Application Needs for IWFIA Products

Display Spatially Explicit Information for Structural Diversity

Vegetation cover is mapped for the entire Forest based on soils maps scaled at 1:24,000. The IWFIA data corroborated FNF Soil Scientist Mike Smith's forestwide existing vegetation/soils map done at a scale of 1:24,000 based on the documentation collected from various soil polygons. These vegetation/soils maps are used regularly for project evaluation and implementation. IWFIA researchers place high value on and have great interest in these soils maps. New IWFIA products might further corroborate these data layers and reinforce the concept of compositional diversity. Mapping of structural diversity is key! Specific examples are distribution of age classes by cover type for all vegetation types including the non-forest types and structure of shrub communities and woody understories. Possibly maps of historical fire patterns

and other disturbances could be derived which would allow function and process to be addressed.

Recently, IWFIA maps were used to stratify sample points for a new stand exam contract for the FNF. Forest specialists realize that not all IWFIA layers are equally useful. Some IWFIA layers appear linked in theme, concept, and display. Maps of biomass, volume, basal area, and density may be correlated and show essentially all the same. Some questions may require additional field investigation. For example, does the IWFIA volume layer equate to biomass or fuel loading as defined by fuels specialists?

Scientific Underpinnings for Forest Plan Revision

Forest planning and resource specialists anticipate that IWFIA maps and other products will provide scientific underpinnings for the forest plan revision process. For management indicator species (MIS), the measure is status and/or trends in populations, habitats, and ecological conditions (USDA Forest Service 2000b). "Selected species populations and habitats representing land and resource management plan objectives that will be tracked to measure progress toward the (2006) milestone" for the area that contains the FNF include aspen and sage grouse in the sagebrush-steppe habitats. Spatially explicit information would be valuable to help meet these MIS monitoring measures and milestones.

IWFIA maps that display information spatially will:

1. enhance our understanding of properly functioning condition and desired conditions
2. tie directly to aspects of fire, fuels, timber, and wildlife management
3. support the forest plan revision process

Summary

In addition to knowing *what* resources the FNF has, spatially explicit displays of *where* those resources occur will be beneficial for multiple issues. To the extent that such maps address structure, composition, and function, these products will link to discussions of biodiversity and sustainability within the framework of properly functioning condition. Such IWFIA products would relate to the resource questions and application needs that exist on the FNF. It will be important to continue to seek opportunities to promote synergy in the development and use of the new IWFIA spatial products that are becoming available.

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